Six inches, Part V

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Residue plays an important role in reducing water requirements for irrigation in our semi-arid environment. In the previous article I wrote about the value of residue in reducing the amount of soil moisture evaporation which occurs during the growing season and throughout the year. I estimate the residue left of the soil's surface will reduce evaporation by at least three inches which is a large amount of soil moisture savings. The elimination of tillage also saves valuable soil moisture. This is a significant amount of moisture we can save in our semi-arid environment by adopting a no till crop production system for our irrigated farming operations. The need for reducing irrigation in our crop production practices is very important so we can conserve our valuable water resource

Residue left on the soil surface also provides a layer of protection for the soil. This plays a significant role in water infiltration into the soil. A soil surface which is left bare is subject to severe soil surface degradation. The soil particles which bond to stabilize the soil are known as soil aggregates. These aggregates allow water to penetrate the soil surface by providing open pores which the water can move through. You can visualize the soil aggregates as acting like a sponge on the soil's surface. Tillage, along with rain droplets or irrigation from center pivots can actually crush these soil aggregates. Once this breakdown occurs, water is unable to penetrate the soil surface and a crust is formed which allows the water to run off the field. The previous crop's residue will protect these soil aggregates by breaking up the droplets before they hit the soil surface. This will allow rainfall and irrigation water to penetrate the soil surface and allow the rain or irrigation water to flow into the soil profile.

Another attribute of no till crop production systems is it allows producers to increase the amount of organic matter in the soil. There are many benefits to increasing the organic matter content of soil. Increased organic matter increases nutrient availability to the crops, increases the amount and diversity of soil microorganisms and feeds these organisms, lowers soil pH, and increases cation exchange capacity in the soil.

When it comes to water management of the soil, increasing the organic matter content of the soil will increase the water holding capacity of the soil. A 1% increase in the organic matter content of the soil will increase the water holding capacity of the soil by as much as a half inch. Most of the increase will occur in the top one foot layer of the soil, but this is a significant increase in the water holding capacity of the soil. If we can increase the amount of water our soils will store by a half to one inch of moisture, this is a significant increase when we are talking about soils that will only hold four to six inches of moisture to start with.

The benefits of adopting no till crop production systems on irrigated crop production acres are significant. The value of leaving residue on the soil surface to protect the soil's surface is immense. Producers will see significantly less water is required to produce their crops as they adopt more continuous no till crop production systems on their farms. This water savings will go a long way in solving some of our water management challenges as we learn to adapt to farming with less water.

As of July 8, we have had no rain so we are running at 5.82 inches for the year and 2.77 inches below normal. We have put 7.5 inches on the winter wheat, 1.5 inches on the corn, and .75 inches on the beans with irrigation.

Six inches, Part VI

I have shown how no till crop production systems can help conserve our valuable surface and groundwater resources with improved water management in producing crops. No till farming practices utilize the previous crops residue to protect the soil's surface and reduce soil moisture evaporation. The residue also improves water infiltration into the soil by protecting the soil aggregates from rain and irrigation droplets. Improved soil structure allows the moisture to infiltrate into the soil profile where it can be stored. Increasing soil organic matter actually increases the water holding capacity of the soil, allowing us to store more water in the soil profile. These changes to the soil take time to develop, but once developed will remain a part of the soil's characteristic as long as tillage is avoided. Tillage is a catastrophic event to the soil.

There is another technology we are using on our farm to help us better manage our soil moisture. We are now using soil moisture sensors on all our center pivots to help us better monitor our soil moisture. Soil moisture sensors are placed at varying depths in the soil profile. On our farm we placed sensors at depths of one, two, three, and four foot deep in the soil profile. These sensors are glued to pvc pipe and are placed in the soil at the varying depths. The sensors will be pulled at the end of the irrigation season and placed in storage to be used again the following year.

The soil moisture sensors are connected by wire to a monitor which is placed outside the field. We placed the soil sensors approximately 150 feet into the field, being sure to get the sensors inside the outside tires of the center pivots. The sensors were placed in an area of the field which represents the majority of the field as far as slope and soil type.

The moisture sensors send a reading to the monitor on regular intervals throughout the day. The monitor reads the moisture sensors in centibars, which is a moisture tension reading. The lower the centibar reading, the more moisture in the soil. For our soils a centibar reading around 33 indicates our soils are at field capacity for moisture. As the soil becomes drier, the centibar readings increase. We use these readings to help us determine when to irrigate our crops based upon the moisture available in the soil profile and the stage of development the crop is in.

We also try to monitor the deeper moisture in the soil profile in the third and fourth foot depth of the soil profile. This is the moisture in the profile we want to make sure the crop uses. If the centibar readings at these depths don't increase during the growing season, we are overwatering the crop and not utilizing the deeper soil moisture for crop development. These depths are also critical that you deplete by the end of the growing season so you have room in your soil profile to store more moisture during the fallow period between crops.

We also use this monitoring system to try and maintain a soil profile that has room to store moisture if we get an inch or two of rainfall during the growing season. If you have the soil profile at field capacity throughout the four foot soil profile, you won't have room to store the moisture Mother Nature may provide and not be able to utilize the "free moisture".

We have found these sensors to be a reliable way for us to monitor the soil moisture on our farm. It takes a while to get used to using them and determining the centibar readings for your soil type. We would take centibar readings from the monitor, then probe the soil at the depth of the reading to get a feel for how wet the soil is at a reading of say 40 centibars. Once we developed a feel for how wet the soil was at certain readings, we were able to check the monitor instead of probe the soil to determine when to irrigate.

The University of Nebraska is also developing a calculator where you can enter your soil type and centibar readings and the calculator will determine how many inches of moisture are available in your soil profile. We found at the end of the irrigation season when you attempt to determine whether to apply another inch to the crop that this was very useful information. Last year we were able to determine in early September that our corn crop had three inches of available moisture in the soil profile. We decided this was enough moisture to finish the crop, so were able to shut the pivot off for the year.

These monitors are relatively inexpensive, costing about $450.00 per center pivot. If you are able to save yourself one inch of irrigation during the first season you install them, they will more than pay for themselves. You will be able to reuse the sensors for years to come. After the sensors are glued to the pvc pipe, you can install the entire system in less than an hour.

At this point we have irrigated the winter wheat with 7.5 inches and are done watering the wheat. We have applied 2.5 inches to the corn, and 1.5 to the edible beans. We also received .3 of an inch, so our totals for July are .3 and brings our yearly total to 6.12 inches and 3.5 inches below normal.

Six inches, Part VII

So how are we going to fully irrigate corn, winter wheat, and edible beans with a total of six inches per pivot per year in our semi-arid environment? We're going to start by not wasting any water!

Tillage, lack of residue protecting the soil surface, poor water infiltration, poor soil structure all lead to poor water storage in the soil. As we adopt more continuous no till crop production systems into our farming operations, these problems will go away. We will begin to capture and store all the moisture Mother Nature supplies us and use this moisture for crop production. Our irrigation water efficiency will improve because the water will enter the soil rather than move to the low spots in the field due to crusting of the soil surface which produces runoff in the field. We can reduce soil moisture evaporation by leaving the residue on the soil surface.

Use of the soil moisture sensors will enable us to better manage the moisture in our soils. This will help to avoid overwatering of the crop. By depleting the soil profile by the end of the irrigation season we will use the moisture Mother Nature provides to replenish to moisture to the soil profile. By leaving the soil moisture profile relatively empty at the end of the irrigation season we can also avoid excess moisture carrying nutrients out of the soil profile and leaching them into our surface and groundwater.

The University of Nebraska researchers are also actively involved in researching the timeliness of irrigation. There may be stages in crop development where we can have crop stress due to lack of moisture and still maintain high yields. Reducing irrigation during these times will not cause yield loss and may also cut down on the amount of irrigation water we pump.

I realize there are a lot of variables in irrigation management which we need to overcome. We go through prolonged dry spells in this area where we need to irrigate around the clock it seems. There will be times during the drought where six inches of moisture per pivot may be unattainable. We have been getting by with eight-to-nine inches per pivot during these dry years.

If we look at our total crop requirements under no till crop production systems I think we can lower the requirements from the conventional tilled soils. I am going to assume we can lower this total requirement by three inches per crop. For corn this would mean a total moisture requirement of 20-22 inches, winter wheat would be 14-15 inches, and dry edible beans would be 12-13 inches.

Up to this point we have irrigated the winter wheat with 7.5 inches, the corn with 2.5 inches and the edible beans with 2.25 inches. We have received .55 inches of rain so far in July, which brings our total for the year to 6.37. Normal rainfall for July is 2.13 inches. At the end of July our normal rainfall on average is 10.72 inches, so we are running about 4.35 inches below normal with about 1 week left in July to catch up.

Six inches, Part VIII

As we discussed in previous articles, our total soil stored moisture and rainfall during the growing season is as follows; for corn there is 6 inches stored in the soil and 11.02 inches of precipitation during the growing season for a total of 17.02 inches before irrigation. Winter wheat receives 3.92 inches from planting through the dormancy period till March. April-June adds an additional 7.33 inches of precipitation which brings our total precipitation to 11.25 inches. Edible beans have 6 inches stored in the soil, receive 6.75 inches during the growing season, for a total of 12.75 inches.

If we add six inches of irrigation to each crop, the totals would be 23.02 inches of moisture for corn, 17.25 inches for winter wheat, and 18.75 inches for dry edible beans. These are all within the range or above the moisture requirements for these crops under a no till crop production system. We may need to move moisture from a crop that doesn't need the full 6 inches of irrigation, such as the edible beans, and use this water for a corn crop which may not have available moisture during the drier months when it is filling grain. This will allow flexibility to the irrigation season depending on when the rains come and what stage each crop is in during development.

I'm not sure we can attain such the goal of using only six inches of irrigation water during the growing season on average for each pivot, but it is a goal to see how well we can manage water and produce profitable crops. It will be interesting to see how this plays out during the growing season. I will continue to post rainfall totals and irrigation use on our farm during the remainder of the growing season.

No till farming methods are still developing and changing each year. New ideas and new machinery development will keep improving the no till farming systems. As we learn more about our soil and all the intricacies that play a part in the soil's relation to crop production, there will be new developments in managing the quality of our soil.

No till crop production systems will play a key role in managing our water resource. The use of new technologies in soil moisture management, crop variety selections, and irrigation management will all have a significant role as we learn to farm with less water and remain profitable in agriculture.

We got .2 of an inch last week, bringing our total for July to .75 inches, normal is 2.13, so we're 1.38 inches below normal for the month, yearly totals are 6.57 inches, normal is 10.72, so we are 4.15 inches below normal. On our irrigation we put 7.5 inches on the wheat, 4 inches on the corn, and 3 inches on the beans.